

## ACTIVITIES OF THE GULF COAST RESEARCH LABORATORY DURING FISCAL YEAR 1979-80: A SUMMARY REPORT

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### ADMINISTRATION

Progress this year was interrupted temporarily by Hurricane Frederic on September 12, 1979. The eye of the storm made landfall east of the Laboratory; consequently, no tidal surge accompanied the hurricane in the local area, but there was enough high water to destroy the Laboratory's new pier on Davis Bayou. In addition to sustaining numerous downed trees and utility lines, the Laboratory facilities received damage totaling about \$80,000.

The greatest impact on the research programs involved the loss of or damage to scientific data, instrumentation, experimental animals and other specimens.

Construction of the Laboratory's oceanographic research vessel resumed following the signing of a contract between the State Building Commission and Bender Shipbuilding and Repair Co., Inc., Mobile, AL. Delivery of the vessel is expected in January 1981. Work on the vessel stopped in 1976, when the original contractor defaulted. The unfinished hull had been moved and stored at Misener Industries, Inc., Tampa, FL.

Because of spiraling costs of construction, the State Building Commission was unable to obtain an acceptable bid for construction of the proposed new Marine Education Center building on the Biloxi campus. Therefore, the building has been redesigned, and will contain about 32,700 gross square feet. The building will provide demonstration and teaching laboratories, a fisheries information and service center, seafood microbiology lab, offices, an auditorium, and an aquaria display. Bids on this building will be taken early in the next fiscal year.

The annual operational budget consisted of \$2,100,000 in State-appropriated funds, \$859,178 in sponsored research and other funds, and \$25,000 in Library Improvement Funds allocated by the 1979 State Legislature.

In addition, the State Legislature appropriated \$175,000 in State matching funds for use by the Mississippi-Alabama Sea Grant Consortium in funding the Mississippi Sea Grant Program.

### BOAT OPERATIONS

The boats that provided essential services included the 65-foot R/V GULF RESEARCHER, used in both the Laboratory's research and educational programs; the 38-foot steel trawler HERMES, used principally in the educational program; three diesel-powered cabin workboats; and some

half-dozen Boston Whalers and other miscellaneous smaller craft powered by gasoline motors. The larger vessels are operated by six full-time boatmen, three of whom are licensed Masters for vessels of up to 100 gross tons. The Boston Whalers and other miscellaneous smaller boats are operated by scientists and technicians to meet the needs of some Laboratory research projects. A new 100-foot research vessel which is being completed at Bender Shipbuilding and Repair Co., Inc., Mobile, AL, is scheduled for delivery to the Laboratory in FY 1980-81.

During the year ended June 30, 1980, R/V GULF RESEARCHER was at sea for 66 days and 27 nights. The HERMES spent 62 days at sea and the smaller boats made innumerable trips over the same period.

### RESEARCH

*ANALYTICAL CHEMISTRY SECTION, Dr. Thomas F. Lytle, Head*

**Sediment-Nutrient Interaction Study** (Funded by Mississippi-Alabama Sea Grant Program [M-ASGP]): Much of the nutrient budget in a coastal estuary is bound in surface sediments. Resuspension of these sediments is known to release some of the nutrients in soluble form, which may or may not pose a danger to the biological community. Because of storms, dredging, and other modes of sediment disturbance prevalent in the Sound, a study was made of sediment-nutrient release and adsorption. Two areas of the Pascagoula River region were studied because of a history of industrial pollution. Sediments from both Bayou Cassotte and the lower Escatawpa River were suspended in site water, and the soluble-nutrient levels were measured. All forms of nitrogen, phosphorus, and silicon showed no increase in water exposed to Bayou Cassotte sediments; whereas dramatic increases were seen with Escatawpa River sediments. Other chemical analyses indicated that the dredging activity in Bayou Cassotte has served to remove most of the leachable material from surface sediments in that area. To substantiate these conclusions, other laboratory experiments are being devised to study the effect of dredging on particulate-bound nutrients.

**Sediment Toxicity Index** (Funded by M-ASGP and Gulf Coast Research Laboratory [GCRL]): A technique is being devised to provide a toxicity rating of sediments in Mississippi Sound. Several factors are involved in achieving an objective means of evaluating the toxicity of sediments.

Two factors that have been investigated are suspension characteristics and toxicological testing. Areas that have been scrutinized are the Escatawpa River and Bayou Cassotte. It was found in three-phase bioassays provided by the Toxicology Group of GCRL, that sediments from Escatawpa River were more highly toxic to mysid shrimp than those from Bayou Cassotte. In associated studies it was found that sediments from the Escatawpa River exhibited a much higher suspension stability than those from Bayou Cassotte. Suspensions of sediments from both regions were studied as a function of suspended solids versus time. The time for solids to drop to 1/2, 1/4, and 1/8 original value was approximately an order of magnitude greater for Escatawpa River sediments than for Bayou Cassotte sediments. These sedimentation rates bear a significant relationship to the sediment-toxicity potential in a particular region; they are being used in conjunction with toxicological data in evaluating the threat posed by contaminated sediments in Mississippi Sound.

**Phenolic Compounds in Sediments of Mississippi Sound** (Funded by M-ASGP): Of the various types of pollutants suggested by National Pollutant Discharge Elimination System (NPDES) permits (industrial and residential discharge limits) as being of concern in Mississippi Sound, phenols are one class of compounds which are evident in a great number of effluents. In an examination of sediment cores from the Sound, phenols have been analyzed as indicators of pollutant penetration into the sediment column, and as historical tags of industrial development in the region. Thus far in the Pascagoula River region, evidence points to deposition of phenolic materials to depths exceeding 10 feet at the parts per million level in the river, and undetermined amounts were seen in regions just east of the river mouth. The significance of these findings is being studied by a careful analysis of the phenols present to specify type and source. Relatively high levels of phenols have been seen at depths in the sediment column that, by other analytical approaches, predate industrial input. A natural source of some phenols is probable.

**Shrimp-Waste Fertilizer Feasibility Study** (Funded by Southern Mississippi Planning and Development District): Samples of shrimp-processing wastes were analyzed in an effort to determine the feasibility of using them as fertilizer in a pilot testing program. Wastes were analyzed by standard fertilizer analytical techniques for organic nitrogen, nitrate, nitrite, ammonia, phosphate, potassium, moisture, sulfur, ash content, calcium, chloride, and several trace elements. Results demonstrated no present threat to the environment from trace metal levels or from soluble salt content. Major nutrients were not as high as expected, but were sufficient to pursue further this use of seafood wastes.

**Polynuclear Aromatic Hydrocarbon-Rapid Scanning** (Funded by M-ASGP and GCRL): The polynuclear aromatic hydrocarbons (PNAs), residues of petroleum pollution, are of great concern because of their carcinogenic properties.

Many pollution studies calling for PNA analysis are handicapped by the time-consuming and very costly measurement techniques usually assumed to be state of the art. Fluorescence scanning (emission, total excitation, and synchronous) is another technique that allows characterization of ring-size distribution of aromatics. The technique has been applied and developed for sediment samples in Mississippi Sound. On the samples analyzed thus far, the technique showed great promise for the routine monitoring of PNAs in sediments, and perhaps in other media as well.

**Heavy Metals in St. Louis Bay** (Funded by E. I. duPont de Nemours & Company, Inc. [Du Pont] and GCRL): The introduction of big industry near St. Louis Bay in 1978, prompted a study of baseline heavy metal levels in bay waters, sediments, and organisms. Surface-water samples were collected every other month during 1978 from eight locations, and a bottom-water sample was collected at a site positioned to monitor tidal input of heavy metals. Water analysis was included to provide "typical" values of instantaneous heavy metal levels in St. Louis Bay. Surface sediment samples were collected twice at 6-month intervals from 15 locations. Sediments which depict an integrated history of metal deposition were used as long-term measures of metal accumulation. As indicators of biological accumulation and magnification, oysters and clams also were collected and analyzed. Several fish-collection trips were made so as to include a greater variety of organisms; however, insufficient numbers were obtained of most species to give statistically meaningful results. Therefore, only *Rangia cuneata* and *Crassostrea virginica* were used in the analytical scheme. Metals analyzed were: arsenic, antimony, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, strontium, titanium, vanadium, zinc, and iron.

Analysis of all samples was completed in November 1979, and a final report of the results has been submitted. These data were discussed from the standpoint of: (1) seasonal variation of metal levels, (2) riverine versus tidal input, (3) soluble and particulate fractionation of heavy metals in the water column, (4) comparisons with previous studies in St. Louis Bay and other geographically similar areas, (5) heavy metal depositional areas in St. Louis Bay, (6) relationship of particulate to sediment metal, and (7) correlation of sediment heavy metals with organic carbon and grain size distribution.

**BOTANY SECTION, Dr. Lionel N. Eleuterius, Head**

**Salt Marsh Vegetational Studies** (Funded by GCRL): Quantitative information was accumulated on the relationship of marsh acreage versus open water in Davis Bay, a very productive estuarine system. In addition, the total area drained and amount of rainfall will be determined in this study of an entire estuarine ecosystem from the plant ecology viewpoint. A detailed vegetative map is being prepared as well as a map of the standing crop of all marshes

surrounding Davis Bay. This work has been expanded to include salt marshes on Deer Island. Vegetational structure of other Mississippi salt marshes is being determined also. These studies will reveal the vegetational and ecological attributes of very productive estuarine systems which may have far-reaching consequences.

**Ecological Studies on Seagrasses** (Funded by GCRL): Plans were made in late 1979 and early 1980 to begin work on seagrasses in FY 1980-81. A proposal has been written for research on this subject.

**Populational Studies on Salt Marsh Species** (Funded by GCRL): This ongoing research was concentrated on the salt marsh rush *Juncus roemerianus*. Considerable population information has been gathered on the species and a portion of it is now in manuscript form. The ultimate goal is to document the distribution and the vegetative growth pattern of the major salt marsh species inhabiting tidal marshes in Mississippi. Such populational studies are of considerable importance in relation to ecological work since ecotypes, single sexes, may dominate or compose large tracts of tidal marsh. Taxonomic work was initiated as part of this study.

**Ecological Studies on the Plant Life of Salt Marshes** (Funded by GCRL): This work involves synecological studies where more than one species compose the vegetation. Included is consideration of the hydraulic aspects of flooding various salt marsh zones, done in cooperation with the Physical Oceanography Section. Grand Bayou, a high-salinity marsh dominated by *Juncus roemerianus* on Deer Island, Mississippi, has been selected for this portion of the study. Tidal inundation and discharge rates can easily be established because of the small, contained ecosystem represented in Grand Bayou. A paper was published on tidal inundation and exposure. Quantitative data on plant productivity and the nutritive discharge of detritus and other water-quality parameters will be assessed on the discharge and on the rising tide. The nutrients of Grand Bayou salt marshes in relation to flood and ebb tides, and the flux of soil-water salinity have been determined and manuscripts are in preparation for publication.

Studies have been initiated of other ecological aspects of tidal marshes. Biotic effects are also considered. Flowering phenology has been determined and a paper is in preparation. Two graduate students received degrees; one did research on the response of the snail *Littorina* to the manipulation of salt marsh vegetation, and the other did research on the response of the vegetation to nutrient enrichment.

**Autecological Studies on Vascular Plants of Mississippi Salt Marshes** (Funded by GCRL): This is essentially an extension of populational studies, in that ecological parameters such as soil nutrients, soil-water salinity, elevation, and other chemical and physical aspects of habitats (i.e., soil texture, evaporation), and the life history of the plant including germination are considered.

**An Illustrated Guide and Key to Salt Marsh Plants** (Funded by M-ASGP and GCRL): The purpose of this

work is to prepare an illustrated guide and key to the salt marsh plants of Mississippi. It entails 200 line drawings and scientific descriptions of local species of vascular plants. Additional funds were received to expand and extend this project.

**St. Louis Bay—Botanical Survey and Plant Ecology of Salt Marshes and Submerged Meadows** (Funded by Du Pont): This work was completed in FY 1979 and the final report was submitted in FY 1980. Vegetational mapping and community composition of salt marshes and submerged grass beds were documented. Standing crop, annual production, and chemical characterization of indicator plants and associated soils were determined as part of a baseline environmental study.

**Herbarium Collection of the Coastal, Estuarine, and Marine Flora** (Funded by GCRL): The herbarium presently houses about 20,000 specimens of plants and includes spermatophytes, algae, and fungi. Most of the collections have been made locally since 1970; they probably compose the most thorough collection of plants found in the northern Gulf of Mexico. Most of the plants have been identified but only a few have been mounted on herbarium sheets. The herbarium is presently being organized and specimens cataloged systematically. Duplicate specimens are exchanged with herbaria throughout the United States, England, Europe, Australia, and South America for collections of their coastal, marine, and estuarine plant specimens. The herbarium serves as a teaching and research collection.

**Tropic versus CONUS Military Materials and Equipment Evaluation Test** (Funded by U.S. Army): This experiment was initiated in the spring of 1979 as part of a nationwide military program to determine the effect of environmental factors on various military materials and equipment. This work was completed in 1980.

**Studies of Plant Colonization on Dredge Spoil** (Funded by GCRL): A considerable amount of information has been compiled over several years on plant colonization of dredged material. In addition, some information on plant succession has been gathered. A more intense field effort has been initiated.

**Productivity and Decomposition Studies on Salt Marsh Plants** (Funded by GCRL): Several studies were completed on this aspect of salt marsh research, including estimates of standing crop, and two regeneration studies. Assessment of decomposition was determined using nylon bags and new methods were developed by the section staff. Manuscripts have been prepared on these projects and hopefully will be published during the coming year.

**ECOLOGY SECTION, Dr. Robert A. Woodmansee, Head**

**Phytoplankton Productivity in St. Louis Bay** (Funded by GCRL): Phytoplankton productivity is a fundamental community process of primary significance to the aquatic food chain. It is affected by a number of naturally occurring variables and is sensitive to a variety of

unnatural environmental perturbations. The photosynthetic rate of phytoplankton is being measured at six locations in St. Louis Bay by both the dissolved oxygen and radioactive carbon techniques, and is being related to light intensity, temperature, nutrients, chlorophyll, community composition, and grazing pressure.

**Environmental Baseline Survey of St. Louis Bay: Benthic Study** (Funded by GCRL): Field collections for this baseline study were completed in November 1979. Approximately 50% of the collections from the second year have been processed and stored at the Laboratory. Results of this continued study will be used in conjunction with data from the first year to investigate seasonal cycles and year-to-year changes in the benthic infauna of St. Louis Bay.

**Population Study of the Amphipod *Cerapus benthophilus* in Davis Bayou** (Funded by GCRL): The possibility of amphipod tubes as a potential high-protein food source for juvenile and adult brown shrimp has been discussed in the literature. *Cerapus benthophilus* inhabits muddy silt bottoms subject to current flow, where it constructs conspicuous mats of interwoven tubes. Thus, the extensive coverage of *C. benthophilus* in coastal marsh systems of the northern Gulf of Mexico may represent an unrealized food source. The purpose of this study is to describe the benthic community associated with these mats, and to determine seasonal fluctuations in abundance of *C. benthophilus* and other associated fauna.

**Mississippi Sound and Adjacent Areas Study—Biological Committee** (Funded by M-ASGP): As a result of numerous existing and proposed dredging activities in Mississippi Sound and adjacent areas, the Mobile District Corps of Engineers has initiated a study to investigate current dredging and dredged material disposal practices. The study will consider the possible development of a regional dredging management strategy, new dredging equipment, and the environmental quality of the study area. The Biological Committee, composed of five GCRL senior staff members, is responsible for aiding in the development of scopes of work for collection of biological data related to the study, for identifying specific techniques and methodologies to obtain and analyze such data, and for using the data in formulating plans and measuring impacts.

*ENVIRONMENTAL CHEMISTRY SECTION, Dr. Julia S. Lytle, Head*

**Broad Spectrum Sediment Contaminant Survey in Mississippi Sound** (Funded by M-ASGP and U.S. Environmental Protection Agency [EPA]): To understand the fate of pollution one must know what types of compounds are present to monitor and study. Discharge permits and pollution incidents in Mississippi Sound indicate that organic-type pollutants are most prevalent. However, previous effluent guidelines and possible abuses of regulations probably have resulted in quite an aggregate of pollution components in the Sound. To study the fate and effects of pollutants, representatives of all important classes of suspect compounds

must be evaluated for inclusion in an analytical scheme. A broad spectrum approach is being taken to determine both major and minor components present in the sediments. There is no predetermined list of compounds. Only recently has the practical and economical pursuit of this goal been made feasible, by the development of computerized gas chromatography-mass spectrometry systems. An agreement continued in effect with the EPA laboratory at the National Space Technology Laboratories (NSTL) in Bay St. Louis, to exchange data for the use of such a system. This agreement, besides providing GCRL with expanded analytical capability, permits the EPA access to a vastly better sampling and analysis base in Mississippi Sound.

**Characterization of Olefinic Hydrocarbons in Carbonate and Clay-Silt Sediments** (Funded by Carnegie Institute, Geophysical Laboratory, Washington, D.C. and GCRL): Residues of organic matter trapped in sediments serve as fingerprints of the biological environments above them. Complex mixtures of compounds are isolated from the sediment and reflect the source of material being deposited (either man-made pollutants or natural deposits from plants and animals). In past studies, some sediments analyzed from the Gulf of Mexico have indicated extremely high concentrations of olefinic hydrocarbons. Some possible sources have been identified, but the characterization of these olefins, other than the simple straight-chain alkenes, has not yet been done. A separation and characterization study on these branched and cyclic olefins is in progress. Processes may be operative in marine sediments which convert olefinic isomers to other configurations thermodynamically more stable; the study will improve our knowledge and comprehension of those post-depositional processes. One particular olefinic compound(s) found in the Gulf only in carbonate sediments has been isolated and documented by publication. Other research groups also report this compound(s), but they also have been unsuccessful thus far in establishing the source and characterization. Because it represents the dominant hydrocarbon of marine carbonate sediments, it is important to clarify its complete identification and role in deposition of carbonaceous sediments.

**Studies of Chemical Constituents of Primitive Plants** (Funded by GCRL): Chemotaxonomic and geochemical studies are continuing on primitive plants. Studies have been completed on ferns, mosses, fungi and lichens. Limited numbers of species of lilies, rushes, sedges and grasses have been analyzed, but additional species collections and analyses must be made to complete the study. There are two purposes of the study. One purpose is to investigate the distribution of biosynthetically related compounds, hydrocarbons, and fatty acids, relate them to a series of ancient plants, and determine what chemical changes took place in the evolution of plants. The other purpose is to establish hydrocarbon and fatty acid distribution patterns which can help in identifying natural source materials and their environments, and in distinguishing them from pollutant sources.



**Relationships of Particulate and Dissolved Organic Matter in Brackish Waters** (Funded by M-ASGP and GCRL): It is important to understand the origin and fate of organic matter in Mississippi estuaries. Dissolved organic carbon (DOC) possibly originates from a different source than does particulate organic carbon (POC). Water samples from the Wolf and Jourdan rivers, and St. Louis Bay are being collected monthly and analyzed for both DOC and POC. In the estuary, organic detritus often represents a major component in the food chain. Detritus can be imported from the Sound and the Gulf or exported from riverine and marsh sources. Evaluation of the sources of DOC and POC will provide insight into import and export from the estuaries, as well as provide a better understanding of the carbon cycle in estuarine waters.

**Sediment Suspension Impact Studies** (Funded by GCRL and M-ASGP): When sediments are suspended by various means (dredging, boating, wind and water scouring), the associated pollutants can be redissolved, oxygen depletion in the water column occurs, and other chemical changes take place. Surface sediments from the Pascagoula River area, including the Escatawpa River and Bayou Cassotte, are being analyzed in experiments devised to duplicate incidents of sediment disturbance. The degree to which toxic materials are adsorbed or released, and the sedimentation rates under varying physical conditions (pH, temperature, salinity) are being measured to determine the impact of contaminated sediment resuspension in various locales of Mississippi Sound. The information gained will be used in evolving guidelines for a coastal zone management policy to be developed by the state Bureau of Marine Resources (BMR).

**Pascagoula River Sediment Deposition Studies** (Funded by M-ASGP and GCRL): Pascagoula River water flows into Mississippi Sound, carrying with it large amounts of suspended sediments. Major flow is to the west and out through Dog Keys Pass. Riverine sediments with associated pollutants can thus migrate across the Sound and into the Gulf. This study was designed to understand better the transport of pollutants and to locate pollutant sinks. Sediment and water samples have been collected along a transect from the mouth of the Pascagoula River to the western end of Horn Island, which is along the path of river flow in the Sound. Aliphatic and aromatic hydrocarbons are being analyzed by fluorescence spectrophotometry and gas chromatography. Riverine sediment transport can be followed because riverine sediments primarily contain terrestrial organic input whose hydrocarbon distributions are characteristic and are readily distinguished from marine organic inputs to sediments. Other chemical parameters unique to Pascagoula River waters are also being investigated as tracers. Transport of Biloxi riverine sediments will be included in this pollution deposition study.

**FISHERIES MANAGEMENT SECTION, Mr. William J. Demoran, Head**

**Oyster Resource Flood Damage** (Funded by GCRL): Investigators monitored the effects of spring flooding on

the oyster reefs in state waters again this year. Some additional mortality was noted on certain reefs, particularly in eastern Mississippi Sound off Pascagoula. However, it appeared that sufficient spawning stocks remain on all reefs to repopulate the damaged areas.

**Oyster Reef Rehabilitation** (Funded by GCRL): Personnel assisted the BMR in planning and supervising its annual oyster reef rehabilitation project. During the project, 21,000 cubic yards of clam shells were spread on oyster reefs in the three coastal counties. Old reefs were enlarged in some areas and some new reefs were constructed. The new reefs should produce oysters for several years without having to be refurbished.

**Seed Oyster Location** (Funded by GCRL): The section aided local oyster growers in locating seed oysters for relaying on private leases prior to the 1979–80 oyster season.

**National Marine Fisheries Service (NMFS), Marine Recreational Fish and Shrimp Survey** (Funded by NMFS through Human Science Research, Inc.): Section personnel coordinated a survey of the Mississippi coastal area, which included hiring and training interviewers, assigning survey dates, and processing interview forms and invoices.

**FISHERIES RESEARCH AND DEVELOPMENT SECTION,  
Dr. Thomas McIlwain, Head**

#### **ANADROMOUS FISHES:**

**Striped Bass Restoration Program—Mississippi Gulf Coast** (Funded by NMFS, U.S. Fish and Wildlife Service [USF&WS] and GCRL): The first segment of the project dealing with the rearing and stocking of striped bass was begun in September 1979. The objectives of the program were to establish, by rearing and stocking, a striped bass population in Biloxi Bay; to stock sea-run striped bass and determine their success; and to establish a source of fry from Mississippi brood fish.

Approximately 389,400 striped bass of South Carolina origin were stocked into Biloxi Bay. The USF&WS provided 198,000 fingerlings from the hatchery at Meridian, MS, and the remaining 191,400 were obtained as fry and reared at GCRL. The fish released by GCRL represented 31% of the total number of live fish received from South Carolina.

An additional 222,800 sea-run striped bass fingerlings were reared from fry obtained from the state of Virginia. The fingerlings released represented 50% of the live fish received from Virginia. These fish, along with 168,000 fingerlings provided by the USF&WS from the Carbon Hill, AL, hatchery were stocked into St. Louis Bay.

A sampling program is in progress to monitor natural reproduction. The program also consists of sampling for juvenile striped bass, and sampling the striper population resulting from previous stocking programs.

**Description and Comparison of the Eggs, Larvae, and Young of the Yellow Bass, *Morone mississippiensis*, with White Perch, and White Bass** (Funded by GCRL): Adult

yellow bass were collected from local streams and spawned in the laboratory. The resulting eggs, larvae, and young are being described and compared to the eggs, larvae, and young of striped bass and white bass. Collections of white bass and yellow bass have been acquired for comparative purposes.

**Food Habits and Feeding Selectivity of Larval Striped Bass under Intensive Culture Conditions** (Funded by GCRL): This is the third year of a three-year study. The study was moved from the laboratory into a production unit. Several types of live foods and prepared dry diets were tested as food for larval striped bass reared under intensive culture conditions. The best growth was achieved by starting the larval fish on live brine shrimp and then switching them to a dry diet fed daily by an automatic feeder. The highest survival was achieved employing a combination diet of wild zooplankton and live brine shrimp nauplii.

#### COMMERCIAL AND RECREATIONAL FISHERIES:

**Contributions to the Life History of the Southern Kingfish, *Menticirrhus americanus* (Linnaeus) in Mississippi** (Funded by BMR): This study was designed to collate all locally available life history data on the southern kingfish. After these data were analyzed, a sampling and analysis program was designed and implemented to fill identified data gaps, particularly emphasizing spawning time and fecundity. Offshore collections are being carried out in cooperation with the NMFS Laboratory in Pascagoula, MS.

**Fishery Monitoring and Assessment** (Funded by NMFS and GCRL): Monthly samples were collected and processed. Verified data and selected analytical programs were stored in the Laboratory computer. Selected analytical programs were used to write and publish reports on the relative abundance, size, growth, and distribution of harvestable species each month.

Cooperative efforts were continued to expand the fishery data base for use in achieving optimum production from Mississippi fishery resources through effective management planning and implementation. Information provided to the Mississippi Department of Wildlife Conservation, Bureau of Marine Resources, National Marine Fisheries Service, Gulf States Marine Fisheries Commission, Gulf of Mexico Fisheries Management Council (GMFMC), fishermen, the fishing industry, and other state and federal agencies contributed to a progressively improving scientific basis for Mississippi marine fishery management.

Special shrimp sampling provided the BMR with a scientific basis for the opening of shrimp fishing seasons. The Bureau opened the season on June 23, 1980, after examining predicted dates and considering economic and social factors. Monitoring of the shrimp resources was continued after the season opened. With the possible exception of the 1980 brown shrimp crop, all resources monitored in this project appeared to be in good condition.

In April 1980, oysters were added to the assessment and monitoring project. Effects of spring floods were monitored

and assistance was provided to the BMR in efforts to rehabilitate flood devastated reefs. Results indicate a good set of oyster spat on newly planted shell and some viable oysters off the Telegraph Reef area. Eight reefs across Mississippi are surveyed monthly.

Specimens collected in this project were provided to students and other agencies on request. The by-catch of the special shrimp sampling program and monitoring samples collected since the fishing season opened are being used as the basis for a master's thesis.

**Fisheries Planning** (Funded by GCRL, NMFS, BMR and GMFMC): Active participation in fishery management planning activities of all concerned agencies in the Gulf of Mexico and several professional societies provided for effective input of Mississippi's interest in all Gulf fishery management planning activities. Fisheries personnel served in important positions including chairmanship and membership in key committees.

**Environmental Baseline Survey of St. Louis Bay, Nektonic Macrofauna** (Funded by GCRL): This project was a continuation of a study initially funded by a private industry through June 1979. The Laboratory supported sampling through September 1979. This sampling effort provided two full years of data and strengthened the baseline data bases.

#### ICHTHYOPLANKTON:

**The Role of Mississippi Sound in Recruitment to Sport and Commercial Fish Stocks** (Funded by M-ASGP and GCRL): Since November 1979, 22 stations covering the entire east-west and north-south extent of Mississippi Sound (including three island passes and three offshore sites) have been sampled for fish larvae with an opening/closing meter net. Overall larval fish abundance progressively increased from winter through early summer with the highest abundance and greatest number of taxa occurring at the island passes and offshore stations. In late spring and early summer, larval abundances rose dramatically within the Sound, primarily due to anchovy spawning. Menhaden, spot, and Atlantic croaker dominated the samples in winter and early spring; in late spring and early summer anchovies were most abundant.

When completed this study will provide a comprehensive overview of the areal and within-water-column distribution of larval fishes within Mississippi Sound. With these data and data on the hydrographic and chemical properties of Sound waters (provided by other GCRL researchers) an effort will be made to describe the possible mechanisms of larval transport into and maintenance within the region. Seasonal occurrence, abundance, and length frequency data will yield insight into the importance of Mississippi Sound to the survival of early life stages of local fishes, especially those of commercial significance in the northern Gulf.

**Cooperative Billfish Study** (Funded by GCRL in cooperation with NMFS): Although billfishes are an important

recreational and commercial resource in the Gulf region, larval stages of three species—blue marlin, white marlin, and sailfish—cannot be readily separated from each other. Larvae could provide a tool for resource assessment purposes, but only if identification can be accomplished with certainty. Work is continuing to resolve larval identification problems within this group.

**Assessment of the Utilization of Mississippi Biloxi Bay Area for Sciaenid Spawning and Early Life History** (Funded by BMR and GCRL): Monthly surface and bottom meter net samples were taken at three stations in Back Bay and at one station in Biloxi Bay, to provide data on the occurrence and abundance of early larval stages of sciaenid fishes, and information on the incidence of spawning in those areas. Sampling was initiated in April and by July 1980, 24 samples had been collected and the fish identified, yielding larvae and juveniles of five species of sciaenids, *Bairdiella chrysura*, *Cynoscion arenarius*, *C. nebulosus*, *Leiostomus xanthurus*, and *Menticirrhus americanus*. During the months sampled, no major concentrations of early larvae, indicative of local spawning, were observed.

**Larval Fish Collection** (Funded by GCRL): Progress was made toward establishing a good working reference collection of identified larval fishes from the Gulf of Mexico region. Identified specimens now number 11,845 representing 52 families. Specimens have been provided as gifts or on loan from Texas A&M University, University of West Florida, Rutgers University, and GCRL. Loans have been made to the Virginia Institute of Marine Science. Personnel from the University of South Alabama, University of Southern Mississippi, Louisiana State University, and Humboldt State University visited and used the collection. The collection is intended as a reference source for systematic and ecological studies on the early life history of fish, as well as a teaching tool for graduate students interested in early life history research.

**Taxonomy of Larval Carangid Fishes** (Funded by GCRL): Taxonomic studies have begun on larvae of carangid fishes of the northern Gulf of Mexico. The jacks and pompanos (family Carangidae) are represented by 25 species and 14 genera in the northern Gulf. Carangids are an abundant and important group of fishes in the northern Gulf and frequently are taken as larvae in plankton samples.

Although other workers have published descriptions for about two thirds of the species, many descriptions are incomplete, some are inaccurate, and none can be relied upon to distinguish prefin formation larvae.

As a result of early studies, a paper was presented at the Annual Meeting of the American Society of Ichthyologists and Herpetologists held at Texas Christian University, June 1980, which outlined the state of the art in larval carangid taxonomy among northern Gulf species, and pointed out specific problems encountered.

**Identification of Goby Larvae** (Funded by GCRL): The gobies, sleepers, and wormfishes (Gobiidae, Eleotridae,

and Microdesmidae) are a group of fishes with about 16 species occurring in the Mississippi Sound estuary. Adults and juveniles are abundant in this area and at times the larvae are abundant in plankton. To date most studies have dealt with adult and juvenile forms only. Little information is available on early life history and larval development of species in these families.

Currently it is possible to identify the larvae of three species, *Dormitator maculatus*, *Gobiosoma boscii*, and *Gobionellus boleosoma*. Within laboratory collections there are numerous other types which have not been identified at this time. Work underway involved the analysis of preserved material and rearing experiments to aid in the identification of the remaining types.

**Age and Growth of Sciaenid Larvae using Daily Increments on Otoliths** (Funded by NMFS): Growth of zero-age fish in the sea has not been well documented, principally because a method for determining the age of larvae and juveniles has not been available until recently. The discovery of daily growth increments on otoliths has made possible the precise determination of age, in days, of larval and juvenile fishes.

Otolith growth increments will be used to determine rates and patterns of early growth of the Atlantic croaker, *Micropogonias undulatus*; spot, *Leiostomus xanthurus*; and sand seatrout, *Cynoscion arenarius*, within Mississippi Sound. Results will be compared with previous estimates of early sciaenid growth in the field which were based on less precise methods, such as mark-and-recapture, and length-frequency analyses.

This was only a preliminary investigation into the growth of larval and juvenile sciaenid fishes. It might lead to more comprehensive studies into factors affecting growth such as ontogenetic changes, and temporal and spatial parameters.

**Identification of Small Larvae of King and Spanish Mackerel** (Funded by GCRL): Both king and Spanish mackerel are important resources in the Gulf of Mexico. Although studies have been published on the early life histories of these two species, small larvae (< 3 mm in length) have not been adequately described. Based on collections taken off Texas, additional characters have been found to aid in the separation and identification of small larvae of the two species. This work was conducted in cooperation with personnel of Texas A&M University. Results are being prepared for publication.

**Patterns of Larval Fish Occurrences in Surface Waters of the Northern Gulf of Mexico** (Funded by GCRL): The Gulf of Mexico is perhaps one of the least known areas around North America in terms of ichthyoplankton, particularly the northern Gulf. Yet this is one of the most diverse areas ecologically and faunistically. Within the "Fertile Fisheries Crescent" there are no published comprehensive accounts (species, time, and space) of ichthyoplankton in offshore waters.

This study, based on a series of monthly (January 1967 to May 1969) nekton collections taken at six stations in

the northern Gulf of Mexico, has yielded some of the first information on spatial and temporal patterns of larval fish occurrences in surface waters in this region. Numerical dominants included menhaden, spot, and pinfish. Spatially, species had abundance centers located either inshore, mid-shelf, or offshore. Temporally, species were classified either as winter or summer types.

Preliminary findings were presented at the 60th Annual Meeting of the American Society of Ichthyologists and Herpetologists in June 1980. Results are being prepared for publication. Aspects to be discussed in the publication include clupeoid dominance, differing early life history strategies of two co-spawning sciaenids (spot and croaker), the strong two-season trend of larval fish occurrences in relation to current circulation patterns and estuarine dependence, and the peak of anchovy abundance mid-shelf relative to anchovy dominance in the surf zone of a barrier island.

#### *GEOLOGY SECTION, Dr. Ervin G. Otvos, Head*

*Offshore Barrier Island Study* (Funded by GCRL): The purpose of the study was to reconstruct the geological history of the barrier islands, including formation conditions and present evolutionary trends. Beach samples were collected during the year from Ship, Horn and Sand islands, and were analyzed. Drilled core samples from previous years were analyzed with respect to microfossil and granulometric content. A cooperative effort on the Pleistocene-Holocene ostracode biostratigraphy in the Mississippi Sound-barrier island area was undertaken with Dr. Paul Krutak, of the University of Nebraska. The accumulated findings are being organized for presentation at professional meetings, and for publication. One paper was published as a chapter in a volume entitled *Barrier Islands* (Academic Press, 1979). Two publications by Otvos from the Conference on Research in the National Parks, November 1979, also dealt with the subject.

*Santa Rosa Island and Sound* (Funded by National Park Service [NPS] and GCRL): Study of the island, its lagoon and adjacent bays continued with granulometric and micropaleontological analyses of earlier drilled core-sample material. Four new coreholes were drilled on the island and one on the mainland to afford complete coverage of the subject area. Results are being prepared for publication. A pamphlet on Santa Rosa Island and the Mississippi-Alabama barrier islands is being prepared in cooperation with NPS scientific personnel for use by visitors to Gulf Islands National Seashore.

*Photogeological Study of Barrier Islands* (Funded by M-ASGP and GCRL): The ongoing development of minor islands has been studied by periodic photographic surveys since 1977. More detailed studies during this year included monthly plane flights over the Mobile Bay ebb-tidal delta area, Dauphin and Horn islands. Recently, the Chandeleur Islands, Louisiana, also were surveyed. These surveys provided

monitoring of island restoration (affecting the recreational, fishing and shipping industry) following the devastation by Hurricane Frederic in September 1979. This project included detailed (aerial photo and field) studies of the youngest barrier island along the Mississippi coast ("Horse-shoe Island," which was "born" in late September 1979), and the evolution of Sand and Dauphin islands which have been severely overwashed.

*Geology of the Mississippi-Alabama Mainland Coast* (Funded by GCRL): This ongoing project studied the Pleistocene and Holocene stratigraphy, and the influence of tectonic structures on coastal geomorphology. Sample material from eight important coreholes, drilled in Harrison and Jackson counties, were donated by three foundation engineering firms. Granulometric and micropaleontological sample analyses are in progress. One paper was prepared for publication.

*Graveline Bayou (Jackson County, Mississippi) Sediment Granulometry* (Funded by GCRL): Samples were analyzed for the Microbiology Section to aid virological studies in sediments.

*Pollutant Transport in Mississippi Sound Sediment Granulometry* (Funded by M-ASGP): Numerous drill-core samples were analyzed for the Environmental and Analytical Chemistry sections.

*Pleistocene Geology in Southeastern Louisiana* (Funded by GCRL): Field and laboratory work were performed on Tunica Hills creek deposits. This work is significant in evaluating the use of radiocarbon absolute age techniques in proven Pleistocene sediment units.

*St. Louis Bay* (Funded by GCRL): Monthly sediment samples were analyzed in the 1979 continuation of the environmental baseline survey of the bay.

*Apalachicola Bay Area Barrier Island Investigations* (Funded by GCRL): Drill material from 14 coreholes in lagoonal, mainland, and island areas were loaned by Florida State University for analysis. Additionally, two coreholes from St. George Island were donated by a foundation engineering firm. Comparative studies of the Apalachicola Bay and Mississippi coast barrier islands are aimed at establishing the existence of an important barrier-island evolution process.

#### *MICROBIOLOGY SECTION, Dr. David W. Cook, Head*

*An Assessment for the Conversion of Seafood Processing Wastes into an Environmentally Acceptable Fire Ant Control Product* (Funded by BMR): Studies were conducted to determine the feasibility of utilizing naturally occurring soil microorganisms (primarily actinomycetes species) to convert processed shrimp shells into metabolic products which might be toxic to the imported fire ant. Procedures were developed for the purification of chitin from shrimp shells; isolation of actinomycetes from soil and marine sediments; growing actinomycete isolated on processed shrimp shells; extraction of metabolic products resultant from these incubations; and

assessment of metabolite toxicity to the imported fire ant. Toxicity evaluations were performed at the Imported Fire Ant Laboratory, Gulfport, MS. Seven different actinomycetes cultures were evaluated using a variety of culture techniques and solvent extractants. To date, no conclusive evidence of metabolite toxicity to the imported fire ant has been ascertained.

**Effluent Toxicity Evaluation: First Chemical Corporation** (Funded by First Chemical Corporation [FCC]): The level of toxicity of the final discharge effluent from FCC, Pascagoula, MS, was determined using sheepshead minnow (*Cyprinodon variegatus*), and possum shrimp (*Mysidopsis almyra*) under standard, acute, flow-through bioassay conditions. Effluent was collected from FCC in April, August and December 1979, and in February and March 1980, and returned to GCRL for testing. Effluent toxicity to sheepshead minnows and mysid shrimp ranged from 100 to 25%, and 75 to 10% (100% represents undiluted discharge effluent), respectively. In all cases, effluent toxicity was found to be in excess of allowable limits for at least one test animal. Test animals utilized in these bioassay evaluations were collected, reared, and maintained under the supervision of Dr. Adrian R. Lawler, Parasitology Section, GCRL.

**Pollutant Transport in the Mississippi Sound** (Funded by M-ASGP and GCRL): In connection with the project directed by Drs. Thomas and Julia Lytle, Analytical and Environmental Chemistry sections, respectively, personnel connected with the Toxicology Program at GCRL are presently conducting three-phase bioassay evaluations on sediments collected from rivers tributary to Mississippi Sound. The three-phase tests consist of evaluating the toxicity of the liquid, suspended particle, and solid phase of each sediment sampled. Test animals utilized in these bioassay evaluations were collected, reared, and maintained by the Parasitology Section.

**Bioconcentration Test: Inter-Laboratory Comparison using the Eastern Oyster** (Funded by EPA): In conjunction with four other laboratories, GCRL is currently conducting bioaccumulation evaluations using selected concentrations of DDE, trichlorobenzene, and pentachlorophenol under standard, flow-through conditions. The eastern oyster (*Crassostrea virginica*) is the test animal in all cases. The Oyster Biology Section has been instrumental in the collection and maintenance of test oysters. Testing consists of an uptake phase in which one set of oysters is exposed to a single concentration of each toxicant until steady state is reached. At that point, toxicant delivery is terminated, and the oysters are allowed to depurate, ideally until 90% of the accumulated test material is voided. Oysters and water are periodically sampled during both uptake and depuration, residual test material is quantitated by gas chromatographic methods, and respective bioconcentration factors calculated.

The DDE, trichlorobenzene, and pentachlorophenol portions of these investigations were completed, and respective

bioconcentration factors generated were 133, 242, and 475.

**Development of Fate/Toxicity Screening Tests** (Funded by Battelle Memorial Institute, Columbus, Ohio, Subcontract No. T-6423(7197)-037, Prime Contract No. 68-01-5043, EPA): This project was a cooperative effort between the EPA-Gulf Breeze (Florida), and the Gulf Coast Research Laboratory to determine the effect of sediment, water, and sediment and water together on the adsorption, hydrolysis, and degradation of selected toxic materials. Partition coefficients for each test material were determined, and toxicity evaluations were developed to ascertain whether or not the disappearance of test compound results in a concomitant decrease in toxicity.

This year, dursban and bolero were processed through the screening process. Methyl parathion was included as a reference compound in each screening evaluation. Considerable effort has been expended in developing a valid toxicity test for the water and sediment fractions produced in the screening portion of this investigation. *Mysidopsis bahia* and a *Gammarus* species are the respective test animals for toxicity evaluations of water and sediment. These animals are provided by the Parasitology Section.

Data generated thus far indicate that dursban dissipates quite rapidly from both water and sediment, adsorbs readily to particulate matter, and is not substantially affected by biological activity. Sediment and water toxicity appear to decrease with time, but the rate of toxicity abatement seems substantially less than that of disappearance of parent compound. Bolero appears significantly affected by biological activity in that disappearance of parent compound in both sediment and water systems is considerably more rapid under septic conditions as compared to sterile conditions. Bolero tends to adsorb less to particulate matter than does dursban, but, like dursban, decreasing bolero toxicity with decreasing recovery of added parent compound has not been demonstrated conclusively.

**Steam Unit to Aid in Oyster Shucking. Part II. Microbial and Organoleptic Tests of Oysters Exposed to Steam** (Funded by BMR): A steam tunnel was designed for use in oyster shucking plants to relax the adductor muscle of oysters and thus facilitate opening. The effect which heat had on organoleptic acceptability, free liquid content, and spoilage rate of oysters was evaluated. A mild heat treatment in which oysters were exposed to a temperature of approximately 60°C and during which the internal temperature was elevated to 40°C did not significantly alter any of the evaluation characteristics. Oysters subjected to higher temperatures scored lower in organoleptic tests but the free liquid content and spoilage rate appeared unaltered. High temperatures accelerated the glycogen bleeding rate, resulting in cloudy oyster liquor which the test panel determined to be undesirable.

**Viral Evaluation of Prohibited Oyster Growing Waters** (Funded by M-ASGP and GCRL): This joint project with the University of Southern Mississippi is designed to assess



the relationship between numbers of pollution-indicator bacteria in the water and the level of viruses found in oysters. GCRL is responsible for water- and oyster-sample collections and bacteriological analysis. Data produced will be available to state and federal regulatory agencies for use in assessing present-day water quality standards.

**Enteroviruses in Prohibited Oysters and Marine Sediments** (Funded by M-ASGP and GCRL): Oyster and sediment samples were collected from Graveline Bayou and adjacent areas, and analyzed for fecal coliform bacteria and enteroviruses. These data will be used to determine if sediments may serve as a reservoir where viruses can be concentrated and from which viruses can be injected by oysters. This project is being conducted jointly with the University of Southern Mississippi, Microbiology Department.

**Investigation of Photozone, A New Economical Disinfectant, to Maintain Suitable Water for Depuration of Oysters taken from Polluted Reefs** (Funded by BMR): Maintenance of water quality is a critical factor in successful operation of a closed-cycle oyster depuration system. This project is a study of the use of a disinfectant known as Photozone to determine if it can adequately control the microbial population in an oyster-holding tank, and otherwise improve the water quality without adversely affecting the ability of the oysters to pump and cleanse themselves.

**Development of Guidelines for Oyster Relaying on the Gulf Coast** (Funded by U.S. Food and Drug Administration): Studies are being conducted to determine the effect of temperature, salinity, and stress on the ability of oysters to eliminate indicator bacteria and enteroviruses. This information, along with existing published data and regulations, will be reviewed to develop new guidelines for oyster relaying. The University of Southern Mississippi has subcontracted the virus portion of the research.

**MICROSCOPY SECTION, Dr. William E. Hawkins, Head**

**Electron Microscopical Studies on the Effects of the Coccidium *Eimeria funduli* on Gulf Killifishes** (Funded by GCRL): Studies are being conducted on the inflammatory response and tissue alterations in livers of *Fundulus grandis* and *F. similis* during infection by the protozoan *Eimeria funduli*. The inflammatory response coincides with the appearance of sexual stages of the parasite and mainly involves monocytes, eosinophils, and heterophils. The parasite develops in a vacuole formed by host membranes. Connective tissue elements predominate in the latter phases of the host response. In higher vertebrates, the inflammatory response does not vary greatly among different species. It is hoped that detailed studies on model systems such as this will help identify mechanisms of combating infection and reacting to cell damage that are common to all fish. A manuscript is in preparation.

**The Response of Leucocytic Cells in the Hemopoietic Kidney of the Spot *Leiostomus xanthurus* and the Croaker *Micropogonius undulatus* to Damage by Cadmium** (Funded

by GCRL): Previous studies have shown that cadmium damages proximal tubule cells in the spot kidney. Currently, other features of heavy metal poisoning in fish are being studied including the fate of damaged tubule cells and the effect of cadmium on leucocytes in the hemopoietic kidney of the spot and the croaker. After metal-induced damage, it appears that the tubules are infiltrated by a type of granular leucocyte; then, cell debris is removed by monocytes. These studies are part of a larger study on the effects of heavy metals on aquatic organisms including mechanisms of damage, tissue responses, and recovery from damage.

**Studies on Intracellular Parasites and Tissue Responses in Oysters** (Funded by GCRL and M-ASGP): These are continuing studies that originally began as a survey of Gulf coast oysters for submicroscopic inclusion bodies that harbor pathogenic microorganisms. The studies have been hampered by spring floods in 1978 and 1979 that killed many of the oysters in Mississippi Sound. To date no inclusion bodies have been found. Although the search for inclusion bodies is continuing, study emphasis has shifted because it became apparent that oysters from different locations had varying degrees of histological lesions, primarily foci of inflammatory cells. Light and electron microscopy are being employed to identify these changes in cells and tissues that might reflect a response to environmental factors. Attention has been focused on the hemocytes of the oyster because they are important in the inflammatory response and have been implicated in idiopathic hyperplastic diseases. A manuscript has been completed on the ultrastructure of oyster hemocytes with emphasis on organelle development and pathology.

**Histopathological Effects of Chlorine and Ammonia on the Mullet *Mugil cephalus*** (Funded by GCRL): Chlorine and ammonia are two possible pollutants associated with ocean thermal energy conversion (OTEC) plants. Histopathological studies have been initiated on the sublethal effects of these substances on mullet. The tissues studied include gill, kidney, liver, and small intestine. Light microscopic examination of plastic-embedded specimens has shown that acute chlorine exposure primarily damages gill lamellae and kidney glomeruli, secondarily. Small intestine and liver do not appear to be affected. Also, the ammonia exposures tested do not cause histopathological damage. These studies are aimed at identifying types and patterns of damage to aquatic organisms following sublethal exposures to toxic agents.

**Transmission and Scanning Electron Microscopic Study of the Kidney of the Atlantic Croaker *Micropogonius undulatus*** (Funded by GCRL): This is part of an ongoing study that hopefully will culminate in a histological and electron microscopical atlas of croaker cells and tissues. A manuscript on the ultrastructure of the croaker kidney was in preparation. The results of this study will provide a basis for determining pathological changes that might result from exposure to various toxicants and environmental factors.

*OYSTER BIOLOGY SECTION, Dr. Edwin W. Cake, Jr., Head*

**Oyster Depuration in Mississippi: Economic Assessments** (Funded by M-ASGP, GCRL, and University of Southern Mississippi): The third phase of a 3-year study was completed. The objective of this study was to estimate the economic feasibility of a proposed 96-bushel, pilot-scale, oyster depuration facility which might be operated on Biloxi Bay, Mississippi. The results of this study showed that the facility, as designed, would not be economically feasible at present prices and interest rates. Also, the present costs of natural cleansing are paid by state and private relaying operations. Alternate sizes and/or designs may be economically feasible.

**Enhancement of Oyster Production in a Tidal Lagoon in a U.S. Park Service Wilderness Area, Horn Island, MS** (Funded by GCRL): This study was conducted to provide the National Park Service with guidelines for improving and effectively managing oyster stocks in a tidal lagoon on Horn Island, a wilderness area. Significant sets of oyster spat occurred on oyster and clam shell cultch materials. Acceptable sets occurred on branches of the wax myrtle plant. The presence of brood oysters in experimental plots appeared to have no significant difference on spat set. Spat-plate samplers indicated the spat set was fairly uniform on all 40 experimental plots. Park Service officials will have to continue to place natural cultch materials in the lagoons of Horn Island, and to restrict the removal of large numbers of commercial-size oysters from those lagoons if the island's oyster stocks are to be adequate for consumption by island visitors.

**Population Dynamics of Selected Oyster Populations in Mississippi Sound and Adjacent Waters** (Funded by BMR and GCRL): This continuing oyster-monitoring program is assessing rates of spatfall, growth, natural and unnatural mortality, and the prevalence of oyster pathogens and predators on Mississippi major reefs. The results of this program are being used to assist the BMR with oyster management decisions such as when and where to plant cultch materials, and when to open various reefs for commercial harvesting and/or relaying.

**Development of an Oyster Management Model Applicable to the Mississippi Oyster Fishery** (Funded by BMR and GCRL): The Oyster Biology and Fisheries Management sections have acquired and are evaluating existing oyster production models for applicability to the Mississippi Sound oyster industry. Staff members are attempting to manipulate and/or modify models for this purpose. Data from the monitoring study (see previous project) will be utilized to operate the chosen model.

**Oyster Depuration in Mississippi: An Evaluation of Off-bottom Cleansing of Oysters** (Funded by GCRL): The second year of this study was significantly expanded from the utilization of single, plastic chicken coops to the use of a 48-tray (chicken-coop bottoms) rack for cleansing oysters from closed shellfish growing waters. The racks, coops,

oysters, and transportation were supplied by the Cap'N Gollott Seafood Company of Biloxi. Laboratory personnel provided technical assistance as well as testing the oysters for confirmation of acceptable cleansing. The results of this cooperative, industry/laboratory study showed that acceptable levels of cleansing are obtained throughout the rack/tray system and within the prescribed 15-day cleansing period. Because of initial successes, the study is being upgraded to operational testing of several racks during various seasonal and environmental regimes.

**Field Investigations: U.S. Fish and Wildlife Service** (Funded by USF&WS): Section personnel conducted ecological field investigations of proposed projects that might impact the Mississippi coastal zone. The investigations enabled the USF&WS to assess U.S. Corps of Engineers permit applications for potential detrimental environmental impacts. This was the second year of a two-year project.

*PARASITOLOGY SECTION, Dr. Robin M. Overstreet, Head*

**Commercial Fishes of Mississippi: Spawning and Miscellaneous Biological Parameters** (Funded by NMFS and GCRL): The first of two tasks in this project was to determine the season of spawning, size of spawning fish, fecundity, and other aspects of reproduction for the spotted seatrout and red drum in Mississippi. The second task involved evaluating specific aspects of migration, feeding, growth, and health of a variety of commercial finfishes and shellfishes. This was the second year of a proposed three-year study.

**Digenea from Marine Fishes of the Northern Red Sea** (Funded by the Israel Academy of Sciences and Humanities): This long-term project will result ultimately in a monograph on piscine adult digeneans of Red Sea fishes for the *Fauna Palaestina* series. Many specimens already have been collected and more are expected within the next three years. Simultaneous work is also being conducted on other parasites of Israeli fishes, some of which have been implicated in diseases of humans who consume the fish and of fish that are reared commercially.

**Pathological Effects of Larval *Thynnascaris* Nematodes in the Rhesus Monkey (*Macaca mulatta*)** (Funded by the U.S. Air Force): This study was completed. Larval *Hysterothylacium* type MB from local foodfish quickly penetrated the stomach and anterior duodenum of the rhesus monkey, eliciting a host response characterized by mucosal hemorrhage and an initial abundance of eosinophils surrounding the worm. A man eating uncooked seafood containing high numbers of these larvae would probably be affected similarly.

**Studies of Parasites of the Northern Gulf of Mexico Region** (Funded by GCRL): Several studies are underway dealing with different parasitic organisms. These studies deal with the taxonomy, systematics, anatomy, life histories, pathological effects, and control of the organisms. Some of these parasites have been implicated in harm to commercial and recreational fishes. The organisms include microbes,

protozoans, metazoans, and even the hosts and potential hosts for the organisms.

**Macroinvertebrate Fauna of Mississippi and Alabama Coasts** (Funded by M-ASGP and GCRL): The two tasks in this project consist of (1) providing a manuscript for an illustrated guide to the macroinvertebrates from the northern Gulf of Mexico beaches, and (2) compiling a checklist and bibliography of estuarine and marine macroinvertebrates of coastal Mississippi and Alabama.

**Experimental Organism Culture Group** (Funded by GCRL): The culture-holding group of the Parasitology Section continued a part of its operation in a portion of the new toxicology building on the Laboratory's main campus. The purpose of this group is to develop techniques for culturing various freshwater and marine organisms, and to supply these organisms to GCRL sections and other state institutions for use in experiments, primarily toxicity testing and parasitological life-cycle studies.

Presently, several species of fishes, algae, copepods, mysids, amphipods, and other species are being reared year round. In addition to facilities in the toxicology building, other facilities include a cold culture lab, a hot culture lab, a large freshwater pond, and a fathead minnow rearing pond.

**Effluent Toxicity Evaluation** (Funded by First Chemical Corporation): This study was conducted in cooperation with the Microbiology Section.

**Development of Fate/Toxicity Screening Tests** (Funded by Battelle Memorial Institute): This study was conducted in cooperation with the Microbiology Section.

**Pollutant Transport in Mississippi Sound** (Funded by M-ASGP and GCRL): This study was conducted in cooperation with the Microbiology, Analytical and Environmental Chemistry sections.

#### **PHYSICAL OCEANOGRAPHY SECTION, Charles K. Eleuterius, Head**

**Hydrographic-Climatic Atlas of Mississippi Sound** (Funded by M-ASGP and GCRL): Work continued on the production of the atlas. Information on the hydrography and meteorology of the area appears in various publications and in forms often not easy to comprehend. The atlas will provide a single source of up-to-date information on the hydrography and climate in a style for ease of understanding.

The development of such a reference volume required extensive statistical analysis of a large set of hydrographic data to determine characteristic seasonal levels and spatial distributions of physical-chemical parameters: pH, temperature, salinity, dissolved oxygen, and density. Statistical measures of central tendency (mean, median) and variability (range, coefficient of variability) of each parameter at four depths (surface, 5 feet, 10 feet, bottom) were depicted

graphically via isopleth charts. Seasonal spatial distributions and variability of nitrite-nitrogen, nitrate-nitrogen, orthophosphate and total phosphate in surface waters were shown in the same manner as the other parameters.

Information on tides, hurricanes, bathymetry, river flows, wave climate, and geographical boundaries of Mississippi Sound was included in addition to the hydrographic parameters. Climatic information included shows typical weather patterns, air temperatures, photic period, and monthly wind velocity distributions.

**Hydrology of St. Louis Bay** (Funded by Du Pont): The analysis and report for the hydrographic baseline study of St. Louis Bay were completed. The objective was the determination of baseline hydrographic conditions using the parameters of water temperature, salinity, pH, dissolved oxygen, turbidity (depth of extinction of visible light), water color, and currents. These parameters were measured at sites in the bay and lower reaches of the rivers. In addition, automated sampling stations continuously recorded wind speed and direction, water elevations, water temperature, pH, dissolved oxygen, and salinity.

The findings of the study were included and discussed in a report that contained over 100 charts showing the spatial distribution of the hydrographic parameters. Composite charts showed the spatial distributions at 1-meter intervals throughout the water column. The empirical relationships between parameters were investigated and the results were included in both graphic and tabular form. Although the study was limited to only 13 months of data acquisition, it provided a comprehensive, first-order investigation of the hydrography of St. Louis Bay.

**Hydrodynamic-Numerical Circulation Model of St. Louis Bay** (Funded by Du Pont): The development of a forward-marching, finite-difference hydrodynamic-numerical model of St. Louis Bay, and the final report were completed. The model, based on the hydrodynamic equations of motion and continuity, allowed for the flooding and subsidence of waters from land areas. The tidal model accommodates wind stress and includes a quadratic form of bed resistance. A 30-second time step was used to provide the necessary spatial resolution to properly represent the basin geometry and current regime. A 29 x 39 uniform grid of topographic and bathymetric values was used to represent St. Louis Bay and adjacent land.

The model, tested initially using a simple sine wave as input, was later tested using prescribed tidal conditions. Lack of tidal measurements at the seaward boundary precluded the input of actual observed conditions for tidal forcing, thus the use of transformed values was employed to prove the proper functioning of the model. Current vector charts and tidal hydrographs were constructed from the model output. Computer programs were written to provide these computer-generated graphics.

The model is a useful tool for investigating the current regime in St. Louis Bay under various tide and wind

conditions. It provides a means of obtaining information on the fate and transport of materials that otherwise would be virtually impossible to obtain. The model can be expanded readily to a water quality model or transformed into a storm surge model.

**Spatial Data Management System** (Funded by the U.S. Corps of Engineers, Mobile District): To evaluate the impact of planned dredging activities upon the environment and to assess the cost/benefit ratio of such projects, the Corps of Engineers must analyze large amounts of various data in an accurate and efficient manner. The development of the spatial data management system entails the design and writing of a system of computer programs to handle, store, and retrieve large quantities of environmental, marine commerce, engineering, socio-economic, and archeological data. These data must be retrievable by a number of indexes. Programs must be developed that will display raw or processed data in a variety of graphic formats via cathode-ray tube (CRT) or hardcopy plotters.

Initial efforts began in March 1980 and involved the acquisition and review of existing programs, and the development of some of the program subroutines. Considerable effort has been devoted to the design of a viable system. The computer terminal, a Tektronix 4051, has been received but the telephone line to connect it with the remote computer has not been installed. The spatial data management system will be developed using a CDC 7600 at Boeing Computer Services, Renton, WA, on which the system will eventually reside. The system will take three years to complete.

**Characterization of Tidal Bayous and Development of Statistical Evaluation/Monitoring Techniques** (Funded by GCRL): This study involves an analysis of physical-chemical parameters recorded for tidal bayous along the Mississippi Gulf coast. The determination of system means and variability will provide a baseline for the respective bayou systems. The study is also providing information on the dynamics of these little-studied but important tidal bayous.

#### PHYSIOLOGY SECTION, Dr. A. Venkataramiah, Head

**Toxicity and Impingement-Entrainment Studies for Ocean Thermal Energy Conversion (OTEC) Plants** (Funded by U.S. Department of Energy): The purpose of this long-term project is to use laboratory bioassays to determine the potential effects of OTEC discharges on tropical marine fauna. The toxicants used in these tests are ammonia and chlorine; the test animals are mullet (*Mugil cephalus*), sargassum shrimp (*Latreutes fucorum*), sargassum fish (*Monocanthus hispidus*), and a copepod species.

In the second year (1979–80), acute bioassays (96 hours) were made by exposing mullet, sargassum shrimp, and sargassum fish initially to a wide concentration range of ammonia and chlorine. Acute bioassays with ammonia were made in a static system, and bioassays with chlorine were made in a flow-through seawater system. In subsequent acute bioassays,

the animals were tested at closer intervals in narrower concentration ranges of ammonia and chlorine than the initial ranges by eliminating the extremely lethal levels. By repeating these bioassays several times the sublethal and incipient-lethal levels of ammonia and chlorine were established. The  $LC_{50}$  and  $LT_{50}$  values were also determined for each species. (In sublethal concentrations none of the animals die in a 96-hour test; in incipient-lethal levels part of the animals but not all of them will die.)

Mullet were tested later for chronic effects in the sublethal concentrations of ammonia and chlorine, by exposing the mullet to the so-called "harmless" doses of each toxicant for about 3 weeks. The survival and behavioral responses were monitored. Internal damage to the gills, kidney, and gut was determined using the electron microscopy techniques in collaboration with the Microscopy Section at GCRL.

A behavioral response pattern was developed from acute bioassays for each species which was different in ammonia and chlorine. Tolerance to these toxicants in the acute test was found to be size related. Larger mullet were more resistant to the toxicants than smaller ones, while in sargassum shrimp and sargassum fish it was the opposite way. Mullet taken from nearshore waters were more tolerant than the offshore sargassum species.

Chronic studies with sargassum shrimp and sargassum fish were begun. Bioassays with copepod species are scheduled for the third year of this contract.

#### SYSTEMATIC ZOOLOGY SECTION, Mr. C. E. Dawson, Head

**Systematic Studies on Fishes of the Families Microdesmidae, Dactyloscopidae, and Syngnathidae** (Funded by GCRL): A report on the family Microdesmidae for the UNESCO publication *Check-list of Fishes of the Eastern Tropical Atlantic (CLOFETA)* was completed, and a similar report on the family Syngnathidae is in preparation.

A manuscript reviewing the western Atlantic sand stargazers (Dactyloscopidae), including 17 species in 7 genera, was completed.

The manuscript treating the family Syngnathidae for the Sears Foundation series *Fishes of the Western North Atlantic* was completed.

Current studies include work leading to review of the gastrophorine estuarine or freshwater pipefishes, synopses of African and Australian pipefish faunas, and a review of the genus *Micrognathus*.

### SPECIAL FACILITIES

#### MARINE EDUCATION CENTER, Mr. Gerald C. Corcoran, Curator

Visits to the Center decreased from 32,754 to 21,182 this year. Several factors are responsible for this decline, such as increased gasoline prices, cancellation of all field trips by several local school systems, and a decreased MEC budget which did not allow any changes in the displays. The largest decrease was in the area of "local public" who

usually visit the Center several times a year to view new animals and new displays.

Two special classes in marine science were taught to 26 students from Sacred Heart Girls High School. The students were exposed to the study of local plants and animals, and to identification of marine vertebrates and invertebrates.

The in-service program for teachers continued with the offering of a new course titled "Marine Science for Elementary Teachers." During the course, teachers developed units of instruction on marine life which included film strips, slide programs, identification using colored photographs, coloring books, and games. When a sufficient number of these units have been developed, they will be consolidated by grade level and distributed to local school systems. The first class had 10 students.

The volunteer summer program had four students this year. They assisted in the care and feeding of the exhibited animals, and thus were informally introduced to the identification of local fishes.

The Creative Learning in Unusual Environments (CLUE) groups took advantage of the Center programs again this year with six groups, a total of 170 students, attending. A similar group of 61 students from Jonesboro, Arkansas, also visited the Center. As in past years staff supervised day and night seining trips, a boat tour of Biloxi Harbor, a visit to Marine Life in Gulfport, and the regular Center program.

Since January 1980, Center staff have been involved in producing a quarterly booklet for the Coastal Heritage Awareness Program. Funded by the Mississippi-Alabama Sea Grant Consortium and the Gulf Coast Research Laboratory, the program involves local teachers and students in providing information gathered from local residents on the historical aspects of coastal living. One booklet has been published and two more are being compiled for distribution at the beginning of the 1980-81 school year.

Personnel acted as a clearinghouse for information on a Manatee which was sighted along the coast during the winter of 1979. Search efforts were coordinated between the U.S. Fish and Wildlife Service, Gainesville, FL, and New Orleans, LA. The state Bureau of Fisheries and Wildlife (formerly Game and Fish Commission), Jackson, MS, was kept informed. Although the animal was not captured, its appearance served to initiate a local network to assure minimum response time to such appearances in the future.

At the request of the Biloxi Library, the Center took part in their Children's Hour program on three occasions by showing a film on snakes and allowing the children a "hands-on" experience with several live specimens from the MEC display. A short talk was given advising children to avoid all unfamiliar snakes.

A workshop was conducted for the Sea Grant Advisory Service-sponsored program to publicize the "Year of the Coast," a nationwide effort to acquaint people with resources of the sea. The correct procedure for seining was demonstrated, and participants were shown techniques used

to identify local marine animals.

A new "Fun Book" was developed similar to one published last year. The booklet features local marine animals and gives hints on their normal coloration. Children at elementary grade levels thus learn body shapes, markings, and coloration of many of the local animals.

#### *THE GUNTER LIBRARY, Mr. Malcolm S. Ware, Senior Librarian*

Standing orders for serial and journal publications were reduced to 221 by eliminating no longer needed titles, and three new subscriptions were purchased.

The interlibrary loan/photocopy program filled requests for 263 reprints this year involving 109 loan transactions for various research projects. There were 176 requests for loans from other libraries.

A total of 102 new books were purchased. Through exchanges and donations, 352 reprints were received and filed.

Recent involvement in networking and consortia include membership in the International Association of Marine Science Libraries and Information Centers, the Gulf Coast Biomedical Library Consortium, and the new Coastal Mississippi Library Cooperative. These affiliations have given considerable depth to the literature acquisitions program, and hold promise for future financial support from both federal and state sources.

Library attendance increased this year from 70 to 85 individuals per day.

#### *ICHTHYOLOGY RESEARCH MUSEUM, Mr. C. E. Dawson, Head*

Two hundred and forty-three lots of fishes, primarily syngnathids and dactyloscopids, were added to the ichthyological collection. These included gifts of important research materials from Australia, the Philippine Islands, New Caledonia and other Indo-Pacific localities. Exchanges, loans, and identifications of specimens were provided for a number of investigators and museums in North America, Europe, and elsewhere.

#### *WATER ANALYSIS LABORATORY, Dr. Thomas F. Lytle, Head*

The Analytical and Environmental Chemistry sections have conducted many of the analyses for a comprehensive pollutant transport study through the Water Analysis Laboratory. Other sections and research groups at the Laboratory taking advantage of the Water Lab services were: Toxicology, Microbiology, anadromous, Office of Fisheries Assistance, Ecology, and Oceanography. Analyses were provided for several graduate students at GCRL to assist in their research. In addition, analyses were performed under contract to the South Mississippi Planning and Development District, and the Arkansas Valley Dredging Co. (for the city of Biloxi). Personnel of the Water Lab served as instructors for the course Marine Chemistry (1980), in some aspects of oceanographic laboratory analysis. Most analysis requests were for water, but sediment, shrimp waste, and fish food also were analyzed.



The tasks performed during 1979–80 included analyses for: orthophosphate, total phosphorus, nitrate, nitrite, ammonia (now reported as un-ionized ammonia), silicate, sulfate, pH, chloride, hardness, turbidity, suspended solids, residual chlorine, alkalinity, calcium, Kjeldahl nitrogen, phenols, silver, copper, potassium, manganese, magnesium, iron, and zinc.

**COMPUTER SECTION, Mr. Gerald Strength, Head**

The total number of jobs processed through the computer center was 2,172 with a total run time of 1027.36 hours. This decrease in utilization from the previous year is due primarily to the winding down of the Du Pont project, and to the limitations caused by the small interval memory (16k) of the present computer. This core size limitation becomes more acute as the sizes of data bases expand and sizes of the programs to handle these larger data bases also expand. Sections contributing largely to the job/hour total were: Finance (303/244.43), Oceanography (345/150.17), Fisheries (236/110.81), Microbiology (128/31.11), with the remaining jobs and hours contributed to the other sections.

A pilot study has been initiated with the objective of determining the computer needs of the Laboratory over the next 10 to 12 years, and recommending the most cost-effective method of meeting those needs.

**PUBLIC INFORMATION/PUBLICATIONS SECTION,  
Miss Catherine Campbell, Head**

In August 1979, the Section staff resumed producing the Laboratory's weekly radio program "On Course," which is devoted to news and interviews concerned primarily with aspects of marine science research and education. A five-minute format was adopted, and by the end of July 1980, fifty new programs had been produced, dubbed and distributed. Programs were recorded on the main campus in Ocean Springs. They are regularly aired over seven regional radio stations: WGCM, Gulfport, 1230 AM, 9:35 p.m. Sunday; WGUD, Moss Point, 106 FM, 11:25 a.m. Thursday; WLOX, Biloxi, 1490 AM, 8:25 a.m. Sunday; WOSM, Ocean Springs, 103.1 FM, 5:55 p.m. Saturday; WPMP, Pascagoula, 1580 AM, 1:35 p.m. Wednesday; WRPM, Poplarville, 108 FM, 10:30 a.m. Tuesday; and WXGR, Bay St. Louis, 1190 AM, 9 a.m. Sunday.

As part of the Laboratory's internal communications, the staff began an informal, photocopied weekly news sheet called "Lab Samplings," which is issued each Friday. Items used pertain to official communications, GCRL-sponsored activities, participation by staff members in outside activities related to their work, visitors, and the Laboratory's governing board.

During the fall of 1979 and spring of 1980, work progressed on updating a Laboratory informational slide program with new color slides and a new taped narrative. In the spring, another slide program was developed entitled "The Estuary: An Important Natural Resource," which is being

used to call attention to the numerous and diverse benefits derived from estuaries.

During the fall of 1979, section personnel completed Volume 6, Number 3 of the Laboratory's technical journal *Gulf Research Reports*. Printing specifications were written, bids received, and a contract awarded; finished copies were received in mid-February and approximately 770 copies were mailed by the section staff.

Work began in January on Volume 6, Number 4. Manuscripts already reviewed, revised, and accepted by the editor were copy edited by the staff for style, consistent usage and other details, then masters were typed in page format for printing. By the end of June, 32 pages had been set.

Earlier deadlines for the submission of manuscripts were adopted by the editorial staff, effective in 1981, as follows: manuscripts exceeding 10 pages should be submitted by April 1, those 10 pages and under by July 1.

During the 1979–80 fiscal year, the staff produced 12 monthly issues of the Laboratory newsletter *Marine Briefs*, completing the eighth and beginning the ninth year of the publication. Articles were written or edited by the staff, and masters typed for the newsletter layouts, which included one 4-page, seven 6-page, and four 8-page editions. The newsletter was printed outside the Laboratory. Approximately 3900 copies were distributed regularly by hand and by mail.

The Section provided Laboratory participation in the exhibits for the annual meeting of the Mississippi Academy of Sciences, held in Biloxi in March, and in the Coast Day '80 program, held in May at Phillips College in Gulfport.

Through news releases and photographs generated by the staff, and by arranging for members of the scientific staff to do radio and television programs, the Section helped provide timely information to the public. In the case of such newsworthy events as the occurrence of the red tide organism, reported for the first time in Mississippi waters, news releases were made to the media almost daily. Staff members assisted news media persons in obtaining interviews and stories throughout the year.

During the past year, more than 80 news releases were disseminated to about 50 selected daily and weekly newspapers, television and radio stations, wire services and special correspondents. In addition, approximately 100 photos of small groups of field trip and summer college students were sent to hometown and campus publications throughout the nation.

To inform students at campuses affiliated with GCRL concerning summer courses offered at the Laboratory, special articles were sent to campus publications, and a radio interview with the Registrar was taped and sent to on- and off-campus radio stations.

Programs were provided by the staff for civic clubs, and members of the technical staff were obtained to speak to civic clubs and to serve as judges for science fairs. Tours of Lab facilities and informational/educational programs were

conducted for more than a dozen high school, college, and other groups.

### ACADEMIC PROGRAM

#### NEW AFFILIATE

Belmont College in Nashville, Tennessee, affiliated with the Laboratory during the year. The number of out-of-state affiliates is now 40.

#### SUMMER SESSION, Dr. David W. Cook, Registrar

The 1979 summer academic session involved 71 students registering individually for a total of 101 student courses. Twenty-nine students registered through Mississippi schools, 35 through out-of-state affiliates, and seven through non-affiliated out-of-state institutions. Courses taught during the 1979 summer session and the instructors were:

Introduction to Marine Zoology, Dr. Buena Ballard,  
Southwestern Oklahoma State University

Marine Vertebrate Zoology and Ichthyology, Dr. J.

William Cliburn, University of Southern Mississippi  
Marine Invertebrate Zoology, Dr. Edwin W. Cake, Jr.,  
staff

Marine Aquaculture, Dr. Edwin W. Cake, Jr., staff

Marine Ecology, Drs. James T. McBee and Robert A.  
Woodmansee, staff

Marine Botany, Dr. R. B. Channell, Vanderbilt  
University

Physical Marine Geology, Dr. Ervin Otvos, staff

Introduction to Behavior and Neurobiology of Marine  
Animals, Dr. Leo S. Demski, University of Kentucky  
Special Problems in Marine Science, staff

During the 1979-80 academic year, 10 students earned credit in the course Marine Science for Elementary Teachers, offered at night at the Marine Education Center located in Biloxi. This course was taught by Mr. Gerald C. Corcoran, staff.

#### GRADUATE RESEARCH PROGRAM

Courses offered in the Graduate Research Program during this period included: Seminar, Special Problems in Marine Science, Special Topics in Marine Science, and Graduate Research in Marine Science. A total of 71 semester hours credit were earned by graduate research students during the year.

Three new students were accepted into this program during the year, and five students completed their degrees. At the end of the year, 11 students in the program were candidates for the master's degree, and seven were candidates for the doctorate.

Each candidate's name, thesis title, degree sought, and home university are listed below according to the senior staff member directing their work:

##### Dr. Edwin W. Cake, Jr.:

David H. Barnes, "Polychaetes associated with an

artificial reef in the north central Gulf of Mexico," M.S., University of Southern Mississippi.

David A. Blei, "A successional study of the hydrozoans inhabiting an artificial reef in the north central Gulf of Mexico," M.S., University of Southern Mississippi.

Alfred P. Chestnut, "Distribution, population dynamics and reproductive biology of the burrowing clam, *Diplothyra smithii* Tyron," Ph.D. degree awarded 1980, University of Southern Mississippi.

William W. Falls, "Food habits and feeding selectivity of larval striped bass, *Morone saxatilis* (Walbaum), under intensive culture," Ph.D., University of Southern Mississippi.

Kenneth Hase, "Enhancement of oyster production in a tidal lagoon in a U.S. Park Service wilderness area," M.S., University of Southern Mississippi.

Roger A. Jennings, "Seasonality and community structure of benthic macroinvertebrates in a riverine estuary," M.S., University of Southern Mississippi.

Katherine A. McGraw, "Growth and survival of hatchery-reared and wild seed oysters in Mississippi Sound and adjacent waters," Ph.D. degree awarded 1980, University of Washington.

John E. Supan, "A comparison of 'off-bottom' relaying of oysters in the Mississippi Sound," M.S., University of Southern Mississippi.

##### Mr. J. Y. Christmas, Jr.:

James R. Warren, "Changes in the population of the juvenile groundfish, *Micropogonius undulatus*, *Leiostomus xanthurus* and *Cynoscion arenarius*, from Mississippi Sound before and after the opening of the 1979 shrimp season," M.S., University of Southern Mississippi.

##### Dr. Lionel N. Eleuterius:

James C. Garrison, "Some relationships of salt marsh vegetation to abundance of the marsh periwinkle *Littorina irrorata* Say," M.S. degree awarded 1980, University of Mississippi.

Stephen H. Sky-Peck, "A study of growth and nitrogen content of *Spartina alterniflora* and *Juncus roemerianus* in response to source and concentration of nitrogen," M.S. degree awarded 1979, University of Mississippi.

##### Dr. Thomas D. McIlwain:

Barbara J. Crowe, "Contribution to the life history of the Southern Kingfish, *Menticirrhus americanus* (Linnaeus) in Mississippi," M.S., University of Mississippi.

Frederick E. Schultz, "Description and comparison of the eggs, larvae, and young of the yellow bass, *Morone mississippiensis*, with striped bass, *Morone saxatilis*, white perch, *Morone americanus*, and white bass, *Morone chrysops*," M.S., University of Mississippi.

##### Dr. Robin Overstreet:

Thomas L. Deardorff, "Adult ascaridoid nematodes from fishes of the northern Gulf of Mexico with notes on some larval forms," Ph.D., University of Southern Mississippi.

Tom E. Mattis, "Larval development of two trypanorhynch tapeworms from Mississippi Sound," Ph.D.,

University of Southern Mississippi.

Mobashir Ahmad Solangi, "Pathological changes in some estuarine fish exposed to crude oil and its water-soluble fractions," Ph.D., University of Southern Mississippi.

**Dr. A. Venkataramiah:**

Ann L. Gannam, "Effects of various proportions of animal and plant protein supplemented with methionine on the growth and survival of the Penaeid shrimp, *Penaeus aztecus* Ives," M.S. degree awarded 1980, University of Southern Mississippi.

Shiao Yu Wang, "Studies on the effect of declining oxygen tension on the respiratory rate of brown shrimp, *Penaeus aztecus* Ives in relation to temperature and size," M.S., University of Southern Mississippi.

**Dr. Robert Woodmansee:**

Zoghul Kabir, "Relationship between the diurnal vertical migration and egg development in planktonic copepods in Mississippi Sound and adjacent northern Gulf of Mexico waters," Ph.D., University of Mississippi.

John P. Steen, "Factors influencing the spatial and temporal distribution of selected crustacean plankton species in Davis Bayou," Ph.D., University of Mississippi.

Michael C. Torjusen, "The distribution, abundance and feeding habits of larval and juvenile bothid flatfishes of Mississippi Sound and adjacent waters," M.S., University of Mississippi.

#### SCIENTIFIC FIELD TRIP PROGRAM

As an adjunct to the teaching program, each year the Laboratory provides living accommodations, classroom laboratories, and essential services to visiting scientific field trip groups made up of college and university students and their professors. Such groups may stay for periods of up to several weeks, live in the dormitory, use Laboratory boats to make collections of marine life from the sea and from the beaches of offshore islands, and study their specimens in the classroom laboratories. During the year the Laboratory was visited by 32 field trip groups. The total number of people involved were 475 professors and students who stayed an average length of 3.0 days. Some came as far as 2,000 miles to study the marine life of the Gulf of Mexico.

#### SPECIAL AND COMMUNITY SERVICES

##### FISHERY ASSISTANCE

*The Biloxi Schooner—A Seafood Industry Newsletter* (Funded by GCRL): The second volume of this monthly publication was printed. Its readership is currently 95, consisting primarily of Mississippi seafood packers and processors, although it is also sent to industry-associated persons in eight other states.

*Seafood Plant Wastewater Sampling Program* (Funded by GCRL): Fisheries assistance service personnel carry out a weekly sampling service which provides seafood plant

owners with data on the pollutant levels of five components of their processing wastewater. Regulations concerning permissible levels are established by the EPA and enforced by the state Bureau of Pollution Control. Advisory services are offered to plant management to help in controlling pollutants.

During the year, 106 visits were made to seafood plants, and 154 hours were spent in collecting 211 samples of wastewater at the plants; the time required to process the samples in the laboratory was 243.5 hours.

A 3-month quality control sampling program was conducted in seafood plants for the Microbiology Section. Two plants were visited on a weekly basis. Bacteria samples were taken with a commercial sampling device and cultured on a prepared packaged medium. Results gave plant owners a general picture of the extent of a bacterial contamination in their plants and on the products.

A 2-month intensive sampling program was conducted at three seafood plants to collect data on the levels of ammonia in their wastewater discharges. This was in response to a proposed rule by the EPA that would classify ammonia as a toxic substance, thus subjecting the plants to severe limitations. These data were tabulated and a three-page letter of comment was sent to the EPA.

An oyster quality sampling program was conducted during the winter months at one plant which was buying large amounts of shucked oysters from Virginia. On the delivery day, all gallon containers would be sampled for their pH reading. There is a good correlation between low pH and poor oyster quality. Because shipments were being checked, the number of poor-quality gallons shipped was reduced.

A "Special Notice" reviewing old and proposed wastewater regulations was written, printed, and distributed to seafood plants. This was done during a period of increased activity on the part of EPA regulatory personnel.

Throughout the year many requests were received by the office for information of all types. These requests came from industry, universities, state agencies in Mississippi and other states, and foundations. The majority of industry requests were for information on processing and packaging equipment that could be used in their operations, and new methods for better preparing standard products. Several small experiments were conducted in the plants in connection with product handling and packaging problems.

*Seafood Sanitation Program* (Funded by GCRL): At the request of processors, the Microbiology Section makes plant inspections and collects samples for bacteriological testing to determine any problem areas. Suggestions are made for correcting any deficiencies noted in plant sanitation practices.

During the fiscal year, 24 visits were made to processing plants, and 273 crabmeat samples were analyzed at the request of industry. Each sample was analyzed for aerobic plate count, coliform and fecal coliform counts, and *Escherichia coli* count.

"Sanitation Notebook for the Seafood Industry," a booklet developed jointly by GCRL, Virginia Polytechnic Institute, and the National Fisheries Institute, was completed. Copies have been distributed to 20 seafood processors in the state.

#### ENVIRONMENTAL AFFAIRS

The Environmental Affairs Committee is composed of all senior scientific staff members and is coordinated by the Ecology Section. The committee provided an interdisciplinary approach to environmental problems in the wetlands and estuaries of Mississippi, primarily as a service to the state's Bureau of Marine Resources. However, the committee also cooperates with other state and federal agencies on special projects that are not under the direct jurisdiction of the BMR. The majority of this work deals with the review of permit requests for work proposed in the wetlands and estuaries. Committee members made comments and recommendations on permit requests. In most cases a site visit was made by representatives of the committee.

#### PUBLIC SEMINARS

The Gulf Coast Research Laboratory hosts a series of staff seminars throughout the year. These seminars are open to the public and speakers include invited scientists as well as officials from various levels of local, state and federal government. The central purpose of the seminars is to promote better dissemination, understanding, and use of scientific information at all levels of society. Seminars presented during fiscal year 1980 were as follows:

"*Boat and Water Safety*," by Ms. Trudy Mills, U.S. Coast Guard Auxiliary, Flotilla 38, July 17, 1979.

"*Immune Mechanisms in Cold-Blooded Animals*," by Dr. L. William Clem, Chairman, Department of Microbiology, University of Mississippi Medical Center, August 14, 1979.

"*Radiation and Its Biological Implication*," by Dr. Kenneth N. Vanek, Medical Radiation Physicist, Keesler Air Force Base, September 11, 1979.

"*Propagation of the American Alligator*," by Mr. William W. Falls, Fisheries Research and Development Section, Gulf Coast Research Laboratory, September 25, 1979.

"*A Biofouling Intensity Study in the Gulf of Mexico*," by Ms. Brenda J. Little, Biologist, Naval Oceanographic Research and Development Activity, National Space Technology Laboratories, October 9, 1979.

"*History of Gulf Coast Research Laboratory—Part I*," by Dr. Gordon Gunter, Director Emeritus, Gulf Coast Research Laboratory, October 23, 1979.

"*Emergency Medical Satellite Communications*," by Dr. William Brundage, Director, Office of Research, University of Southern Mississippi, November 13, 1979.

"*Mariculture in India*," by Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute, Cochin, India, November 21, 1979.

"*Genitalia Development in the Shrimp, *Penaeus indicus* H. Milne Edwards 1837 from Sundarban Estuary, Bangladesh*," by Mr. Zoghul Kabir, Ecology Section, Gulf Coast Research Laboratory, December 11, 1979.

"*Evolution of the Isthmus of Panama and Adjacent Areas*," by Mr. Allen Lowrie, Oceanographer, Naval Ocean-

graphic Office, National Space Technology Laboratories, December 18, 1979.

"*Resource Utilization in Fisheries*," by Dr. Steve Ross, Associate Professor of Biology, University of Southern Mississippi, January 8, 1980.

"*Marine Turtle Research on the Atlantic Coast of Florida*," by Dr. Llewellyn Erhardt, Barnett Professor of Environmental Science, University of Central Florida, February 12, 1980.

"*Morphology of Tadpole Tails and their Evolutionary Significance*," by Dr. Otto Sokol, Assistant Professor, Department of Anatomy, University of South Alabama Medical School, March 11, 1980.

"*Barrier Island Formation—Gulf Coast*," by Dr. Ervin Otvos, Head, Geology Section, Gulf Coast Research Laboratory, April 8, 1980.

"*Development and Applications of an Airborne Low Light Level Sensor for Marine Fisheries Research*," by Mr. Charles M. Roithmayr, Fishery Research Biologist, National Marine Fisheries Service, May 13, 1980.

"*Economics of the Seafood Industry in Mississippi*," by Dr. Gary B. Perkins, Economist, Cooperative Extension Service, Mississippi State University, Food and Fiber Center, June 10, 1980.

"*Distribution, Population Dynamics, and Reproductive Biology of the Burrowing Clam, *Diplothyra smithii* Tryon*," by Dr. Alfred P. Chestnut, Oyster Biology Section, Gulf Coast Research Laboratory, June 24, 1980.

#### STAFF PUBLICATIONS

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